

**2.3MHz, 2A Synchronous Step-Down Converter Regulator****Features**

- Input voltage range from 2.5V to 5.5V
- Continuous Output Current: 2A
- 2.3MHz Constant Frequency Operation
- High Efficiency: Up to 95%(@3.3VOUT)
- No Schottky Diode Required
- Output Voltage as Low as 0.6V
- PFM Mode for High Efficiency in Light Load
- 100% Duty Cycle in Dropout Operation
- Low Quiescent Current: 40uA
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- Input over voltage protection(OVP)
- <1uA Shutdown Current
- Available in SOT-23-5 package

**Applications**

- Digital Set-top Box (STB)
- Wireless and DSL Modems
- PDAs
- Portable Instruments
- Digital Still and Video Cameras
- PC Cards

**General Description**

The HCR3112 is a 2.3MHz constant frequency, current mode step-down converter. It is ideal for portable equipment requiring very high current up to 2A from single-cell Lithium-ion batteries while still achieving over 95% efficiency during peak load conditions with 5V input and 3.3V output application. The HCR3112 also can run at 100% duty cycle for low dropout operation, extending battery life in portable systems while light load operation provides very low output ripple for noise sensitive applications. The HCR3112 can supply up to 2A output load current from 2.5V to 5.5V input voltage and the output voltage can be regulated as low as 0.6V. The high switching frequency minimizes the size of external components while keeping switching losses low. The internal slope compensation setting allows the device to operate with smaller inductor values to optimize size and provide efficient operation. The HCR3112 is offered in a 5-pin, SOT package, and is available in an adjustable version.

The device offers two operation modes, PWM control and PFM mode switching control, which allows a high efficiency over the wider range of the load.

**SOT-23-5****Figure 1. Package Type of HCR3112**

## 2.3MHz, 2A Synchronous Step-Down Converter Regulator

### Pin Configuration

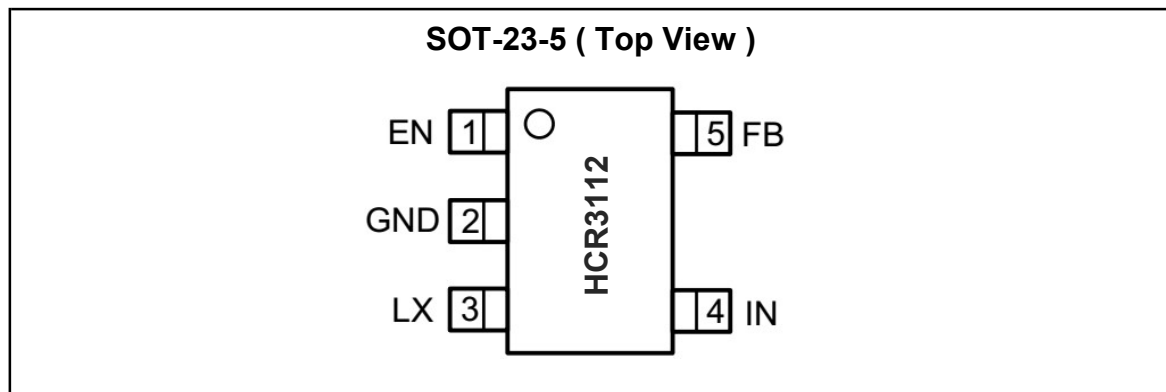
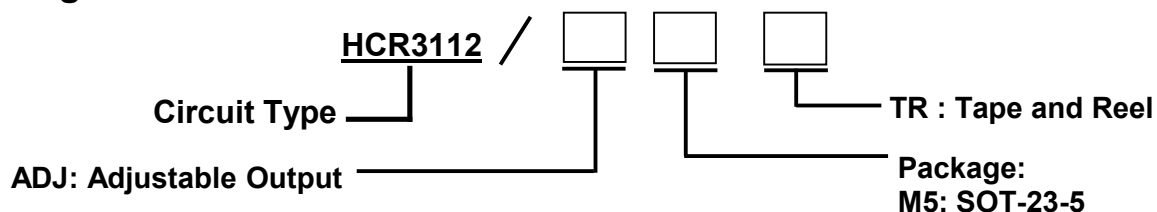


Figure 2. Pin Configuration of HCR3112 (Top View )

### Pin Function Table

Pin Number	Pin Name	Function
1	EN	Chip Enable Pin. Drive EN above 1.5V to turn on the part. Drive EN below 0.4V to turn it off. Do not leave EN floating.
2	GND	Ground Pin
3	LX	Power Switch Output. It is the switch node connection to inductor. This pin connects to the drains of the internal P-ch and N-ch MOSFET switches.
4	VIN	Power Supply input pin.
5	FB	Output Voltage Feedback Pin.

### Ordering Information



### Ordering Code

Part Number	Marking ID <sup>note2</sup>	Temperature Range	Package	Quantity per Reel
HCR3112/ADJM5TR	T2HYXX	-40'C to +85'C	SOT-23-5	3000pcs/TR

Note 2: "T2H" is device code, "Y" is year code and "XX" is lot number code.

**2.3MHz, 2A Synchronous Step-Down Converter Regulator****Absolute Maximum Ratings** <sup>Note 1</sup>

Parameter	Symbol	Value	Unit
Input Supply Voltage Range	V <sub>IN</sub>	-0.3 to +6.0	V
LX Voltage Range	V <sub>LX</sub>	-0.3 to +6.0	V
EN Voltage Range	V <sub>EN</sub>	-0.3 to +6.0	V
FB Voltage Range	V <sub>FB</sub>	-0.3 to +6.0	V
Adjustable Output Voltage Range	V <sub>OUT</sub>	0.6 to 5.5	V
Power Dissipation	P <sub>O</sub>	600	mW
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	168	'C/W
Thermal Resistance Junction to Case	R <sub>θJC</sub>	63	'C/W
Storage Temperature Range	T <sub>STG</sub>	-65 to 150	'C
Operating Junction Temperature	T <sub>J</sub>	-40 to +85	'C
Lead Temperature (Soldering, 10s)	T <sub>LEAD</sub>	260	'C
Human Body Model for all pins	V <sub>ESD_HBM</sub>	±2000	V
Charge Device Model for all pins	V <sub>ESD_CDM</sub>	±1000	V

Note 1: Stresses beyond those listed under "Absolute maximum Ratings" may damage the device.

2: The device is not guaranteed to function outside the recommended operating conditions.

**Recommended Operating Conditions**

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range	V <sub>IN</sub>		2.5	-	5.5	V
Operating Junction Temperature Range	T <sub>J</sub>		-40	-	+125	'C

**2.3MHz, 2A Synchronous Step-Down Converter Regulator**
**Electrical Characteristics**

(VIN=VEN=3.6V, VOUT=1.8V, TA=25°C, unless otherwise noted.)

Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Input Voltage Range	VIN		2.5	-	5.5	V
Input OVP Threshold	VOVP	VIN rising	-	5.8	-	V
UVLO Threshold	VUVLO	VIN rising	-	2.4	-	V
UVLO Hysteresis	VUVLO-HYS		-	0.4	-	V
Quiescent Current	IQ	VEN=2.0V, IOUT=0 VFB=VREF*105%	-	40	100	uA
Shutdown Current	ISHDN	VEN=0V or EN=GND	-	0.1	1.0	uA
Regulated Feedback Voltage Accuracy	VREF	TA=25°C, PWM Operation	0.591	0.600	0.607	V
On Resistance of PMOS	RDS(ON)1	ILX=100mA	-	120	-	mΩ
On Resistance of NMOS	RDS(ON)2	ILX=100mA	-	70	-	mΩ
Peak Current Limit	IPCT	VIN=5V, VOUT=90%	-	2.7	-	A
Oscillation Frequency	FOSC	VOUT=100%	-	2.3	-	MHz
		VOUT=0V	-	350	-	KHz
EN High Level Input Voltage	VEN-H		1.5	-	-	V
EN Low Level Input Voltage	VEN-L		-	-	0.4	V
EN Leakage Current	IEN_LC		-	0.01	1.0	uA
LX Leakage Current	ILX_LC	VEN=0V, VIN=VLX=5V	-	0.01	1.0	uA
Maximum Duty Cycle	η	VFB=0.6V	-	95	-	%
Minimum On-Time	TON		-	60	-	nS
Minimum Off-Time	Toff		-	90	-	nS
Soft Start	Tstart		-	-	1.2	mS
Thermal Shutdown <sup>note3</sup>	TSHDN		-	155	-	°C
Thermal Hysteresis	THYTS		-	20	-	°C

Note 3. Thermal shutdown threshold and hysteresis are guaranteed by design.

## 2.3MHz, 2A Synchronous Step-Down Converter Regulator

### Functional Block Diagram

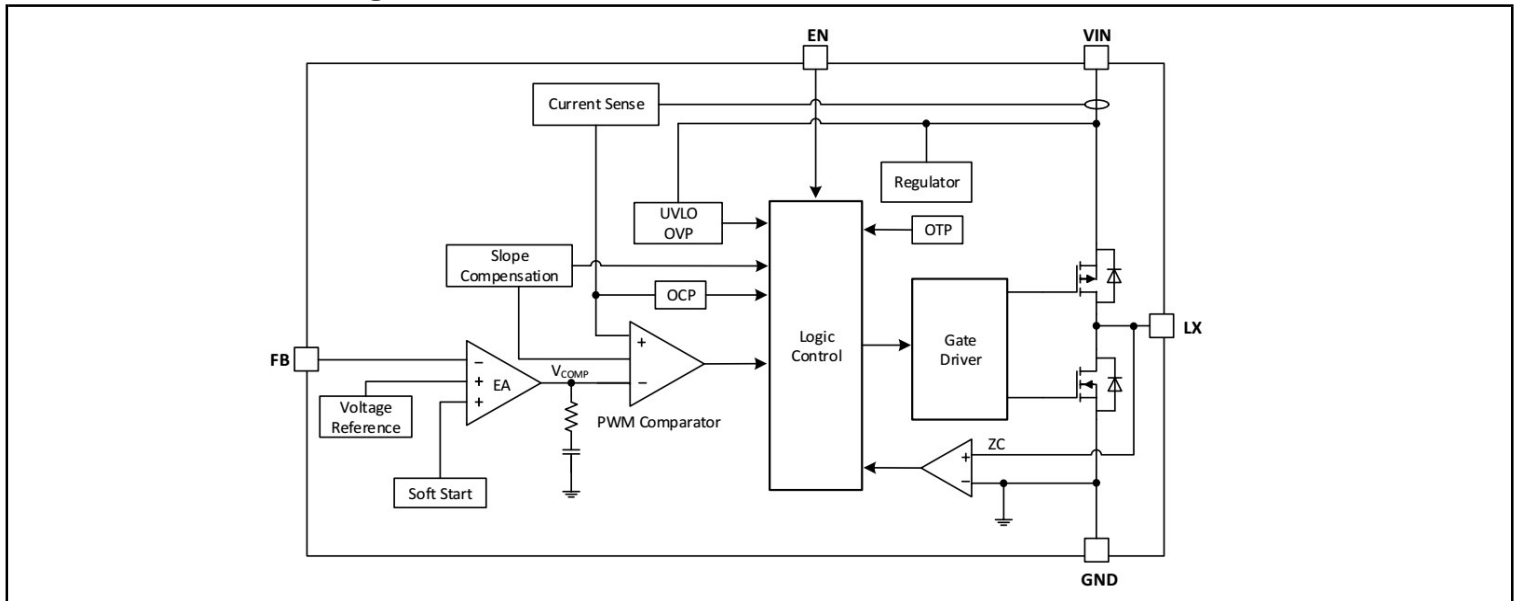


Figure 3. Functional Block Diagram of HCR3112

### Typical Application Circuit

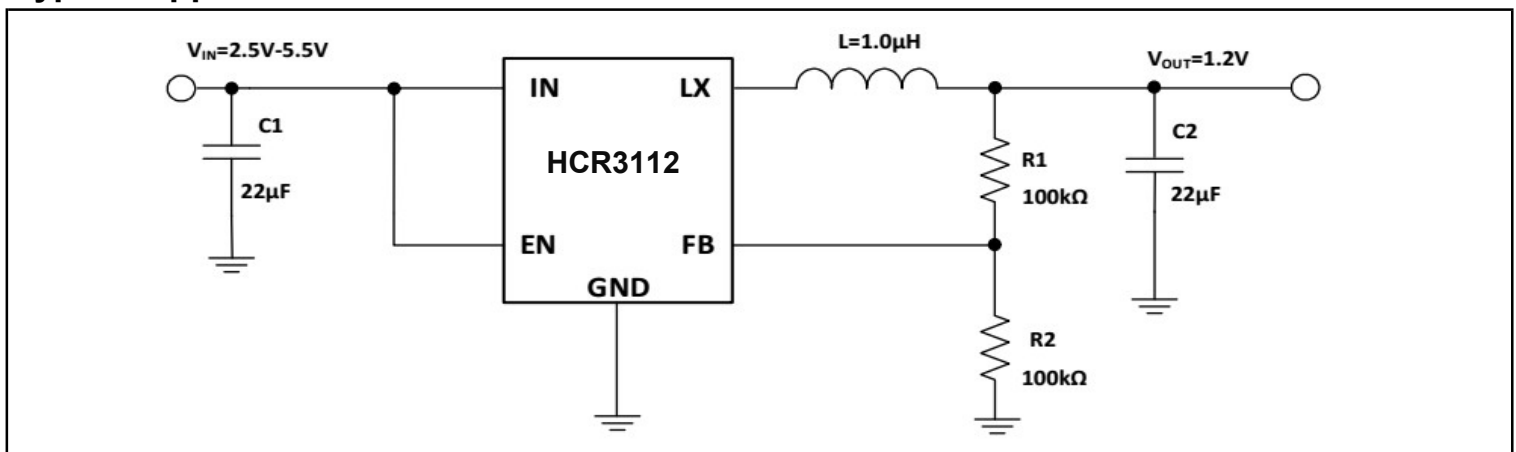


Figure 4. Typical Application Circuit of HCR3112

### Function Description

The HCR3112 is a high output current switch mode step-down DC-DC converter. The device operates at a fixed 2.3MHz switching frequency, and uses a slope compensated current mode architecture.

This step-down DC-DC converter can supply up to 2A output current at V<sub>IN</sub>=5.0V and has an input voltage range from 2.5V to 5.5V. It minimizes external component size and optimizes efficiency at the heavy load range. The slope compensation allows the device to remain stable over a wide range of inductor values so that smaller values with lower DCR can be used to achieve higher efficiency. Only a small bypass input capacitor is required at the output.

The adjustable output voltage can be programmed with external feedback to any voltage, ranging from 0.6V to near the input voltage. It uses internal MOSFETs to achieve high efficiency and can generate very low output voltages by using an internal reference of 0.6V. At dropout operation, the converter duty cycle increase to 100% and the output voltage tracks the input voltage minus the low R<sub>DS(ON)</sub> drop of the P-channel high-side MOSFET and the inductor DCR. The internal error amplifier and compensation provides excellent transient response, load and line regulation. Internal soft start eliminates any output voltage overshoot when the enable or the input voltage is applied.

## 2.3MHz, 2A Synchronous Step-Down Converter Regulator

### Application Information

#### Setting the Output Voltage

The HCR3112 require an input capacitor, an output capacitor and an inductor. These components are critical to the performance of the device. HCR3112 are internally compensated and don't require external components to achieve stable operation. The output voltage can be programmed by resistor divider.

$$V_{OUT} = 0.6 \times \left(1 + \frac{R_1}{R_2}\right)$$

$$R_1 = (V_{OUT} / 0.6 - 1) \times R_2$$

#### Selecting the Inductor

For most designs, 1uH inductance can satisfy most application conditions. Inductance value is related to inductor ripple current value, input voltage, output voltage setting and switching frequency. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where  $\Delta I_L$  is inductor ripple current. Large value inductors result in lower ripple current and small value inductors result in high ripple current, So inductor value has effect on output voltage ripple value. DC resistance of inductor which has impact on efficiency of DC/DC converter should be taken into account when selecting the inductor.

#### Input Capacitor Select

The input capacitor reduces the surge current drawn from the input and switching noise from the device.

The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input.

A low ESR input capacitor sized for maximum RMS current be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients.

A 10uF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

#### Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R & X7R dielectrics are recommended due to their low ESR and high ripple current ratings.

The output ripple  $\Delta V_{OUT}$  is determined by:

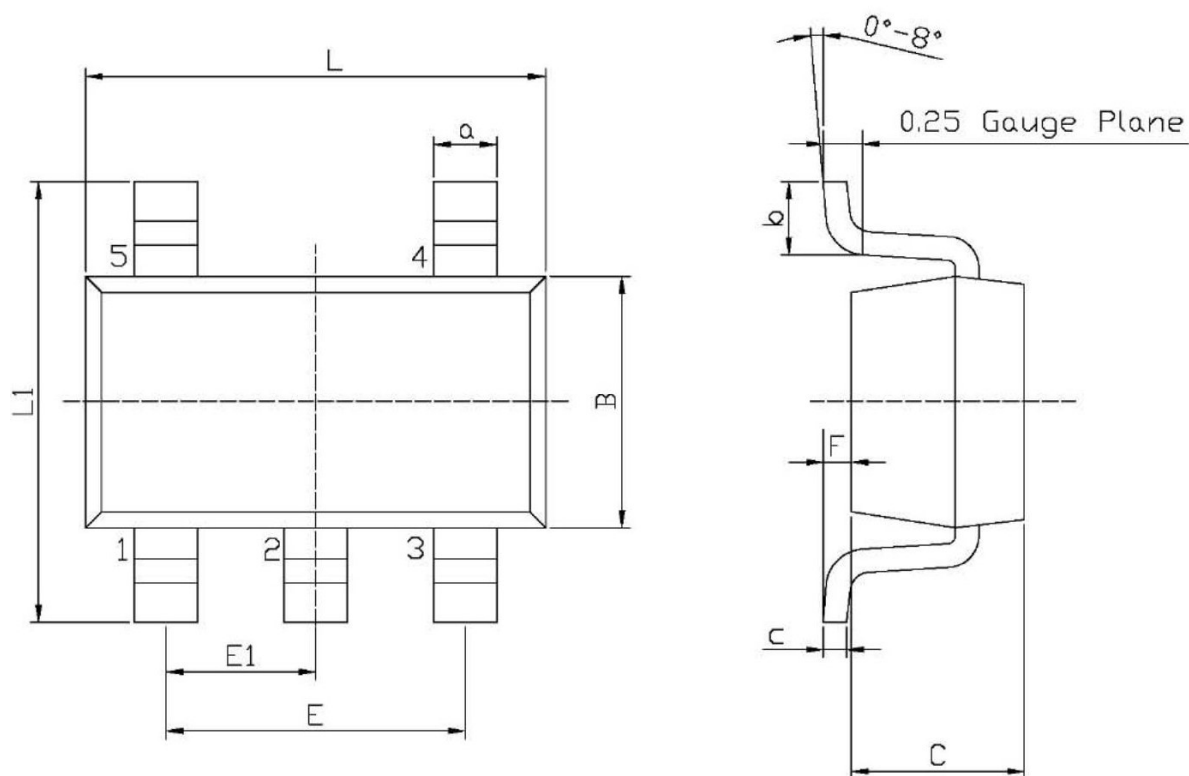
$$\Delta V_{OUT} \leq \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left( ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

A 22uF ceramic can satisfy most applications.

#### Layout Consideration

when laying out the printed circuit board, the following checking should be used to ensure proper operation of the HCR3112. Check the following in your layout:

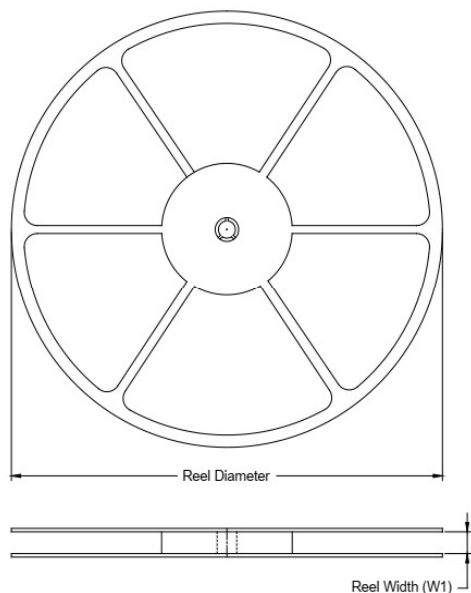
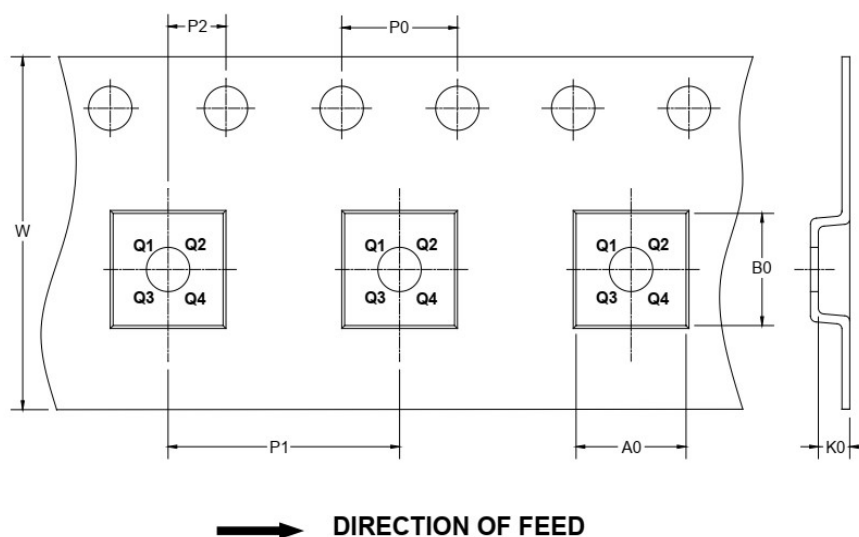
- 1.1) The power traces, consisting of the GND trace, the LX trace and the VIN trace should be kept short, direct and wide.
- 1.2) Does the (+) plates of  $C_{in}$  connect to  $V_{in}$  as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
- 1.3) Keep the switching node, LX, away from the sensitive VOUT node.
- 1.4) Keep the (-) plates of  $C_{in}$  and  $C_{out}$  as close as possible

**2.3MHz, 2A Synchronous Step-Down Converter Regulator**
**Mechanical Dimensions**
**M5 PKG: SOT-23-5**
**Unit: mm**


Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Typ	Max		Min	Typ	Max
L	2.82	2.92	3.02	E1	0.85	0.95	1.05
B	1.50	1.60	1.70	a	0.35	0.425	0.50
C	0.90	1.10	1.30	c	0.10	0.15	0.20
L1	2.60	2.80	3.00	b	0.35	0.45	0.55
E	1.80	1.90	2.00	F	0	0.075	0.15

**Note:**

- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading top mark from left to right.

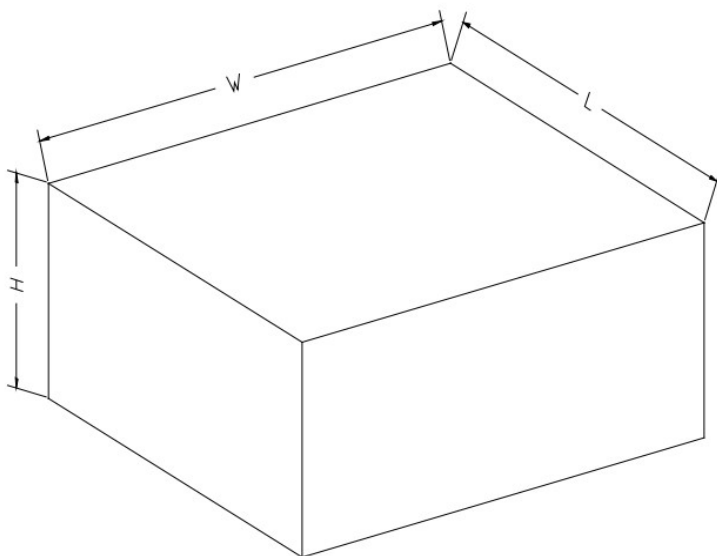
**2.3MHz, 2A Synchronous Step-Down Converter Regulator**
**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


NOTE: The picture is only for reference. Please make the object as the standard.

**KEY PARAMETER LIST OF TAPE AND REEL**

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3



**2.3MHz, 2A Synchronous Step-Down Converter Regulator****CARTON BOX DIMENSIONS**

NOTE: The picture is only for reference. Please make the object as the standard.

**KEY PARAMETER LIST OF CARTON BOX**

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7"	442	410	224	18